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Economic Considerations in Use and Management of Gambel Oak for Fuelwood

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RESEARCH SUMMARY

Samples of 90 trees in north-central Utah were examined to determine growth rates for Gambel oak. These growth data were used in an analysis to determine per-stem values of oak as residential fuelwood.

Some oak stands in north-central Utah contain large amounts of wood. Current estimates of the stumpage value of better stands of oak range up to $2,300 per stocked acre. Oak in the sample achieved minimum harvest size in about 55 years. The annual rate of growth declined rapidly until leveling at about 2 percent. This annual percentage increase in volume is used in comparing the income from harvesting with the income of alternative investments. Current high rates of returns on alternative investments and the risks of holding oak on the stem indicate maximum return could be obtained by harvest as soon as the minimum size is reached.

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INTRODUCTION

Gambel oak (*Quercus gambelii* Nutt.) is a species occurring over a broad area in Arizona, Colorado, New Mexico, and Utah (fig. 1). Oak is the dominant overstory vegetation on 9 million acres (3.64 million ha) (Tiedemann and others, unpublished). Gambel oak is a member of the Fagaceae (beech) family and varies from a small shrub to a medium-sized tree. Oak often achieves a full tree form on better soils and where about 20 inches (50.8 cm) of water is available (Christensen 1949; Arnow 1971; Brown 1958). The farther south in the range of oak, the larger the tree forms become (Reynolds and others 1970; Barger and Ffolliott 1972). Common woody associates at low to mid-elevations (4,000 to 6,000 ft or 1 300 to 2 000 m) are bitterbrush (*Purshia tridentata* [Pursh] D.C.), pinyon pine (*Pinus edulis* Engelm.), Utah juniper (*Juniperus osteosperma* [Torr.] Little), chokecherry (*Prunus virginiana* L.), Vasey big sagebrush (*Artemisia tridentata* Nutt. var. *vaseyana*), Saskatoon serviceberry (*Amelanchier alnifolia* Nutt.), and Utah serviceberry (*A. utahensis* Koehen). These associated woody species normally comprise less than 10 percent of the total stand density. Bigtooth maple (*Acer grandidentatum* Nutt.) and snowberry (*Symphoricarpos* spp.) become the principal woody associates of Gambel oak at elevations between 6,000 and 8,000 ft (1 800 and 2 440 m) (Arnow 1971; Brown 1958; Christensen 1949; Horton 1975; Kunzler and others 1981; Wright and others 1973).

Most reproduction or regeneration of oak stands is accomplished by sprouting from rhizomes and lignotubers (Harper and others, unpublished; Christensen 1949; Clary and Tiedemann, unpublished). The sprouting occurs immediately after disturbance or removal of top growth by fire or other means, and significant growth may occur in a matter of weeks.
Sprouts of 4.72 inches (12 cm) high were observed at several locations in the Canyon Mountains less than 3 weeks after large fires during July 1981. Resprouting after cutting is somewhat less dramatic and slower to appear than after burning but is still adequate for stand replacement (Perry and Opfar, personal communication).

Oak has been recognized as an important forage and cover species for game animals particularly during the summer months (Kufeld and others 1973; Reynolds and others 1970). Even though more palatable and nutritious species exist, oak is also used by big game on some winter ranges (Welch and others 1983). Oak is generally considered an inferior and undesirable species in terms of livestock and forage. Consequently, much study has been directed at control or eradication methods (Horton 1975; Marquiss 1971; Van Epps 1974).

Because of its close proximity to settlements, oak was used by early settlers as fuel, fenceposts, and poles. But oak posts have a short life, as documented in Arizona experiments (Barger and Ffolliott 1972). With the ready availability of other fuels, the use of oak wood as a major home energy source declined and remained at low levels until the energy crises of the early 1970's. The superior heat-producing qualities of oak and its accessibility and close proximity to major population centers have generated considerable interest in management of the species (Harper and others, unpublished). Retail prices reflect the superior heat-producing value of oak: it is sold for $10 more per ton than any other species (Johnson and Grosjean 1980). Oak is currently offered by many wood dealers.

With the increased demand for oak fuelwood has come a heightened interest in management of the species (USDA Forest Service 1983). This interest is broad based because ownership of oak is distributed among private, State, and Federal holdings. Reviews of the current literature indicate little scientific information for basing decisions on managing oak on a continuing basis as fuelwood (Horton 1975; Harper and others, unpublished).

This report presents economic information about using Gambel oak for production of fuelwood. The question of whether managing oak is the most profitable use of land is not directly addressed, but the information presented could be used to show returns for specific parcels of land.

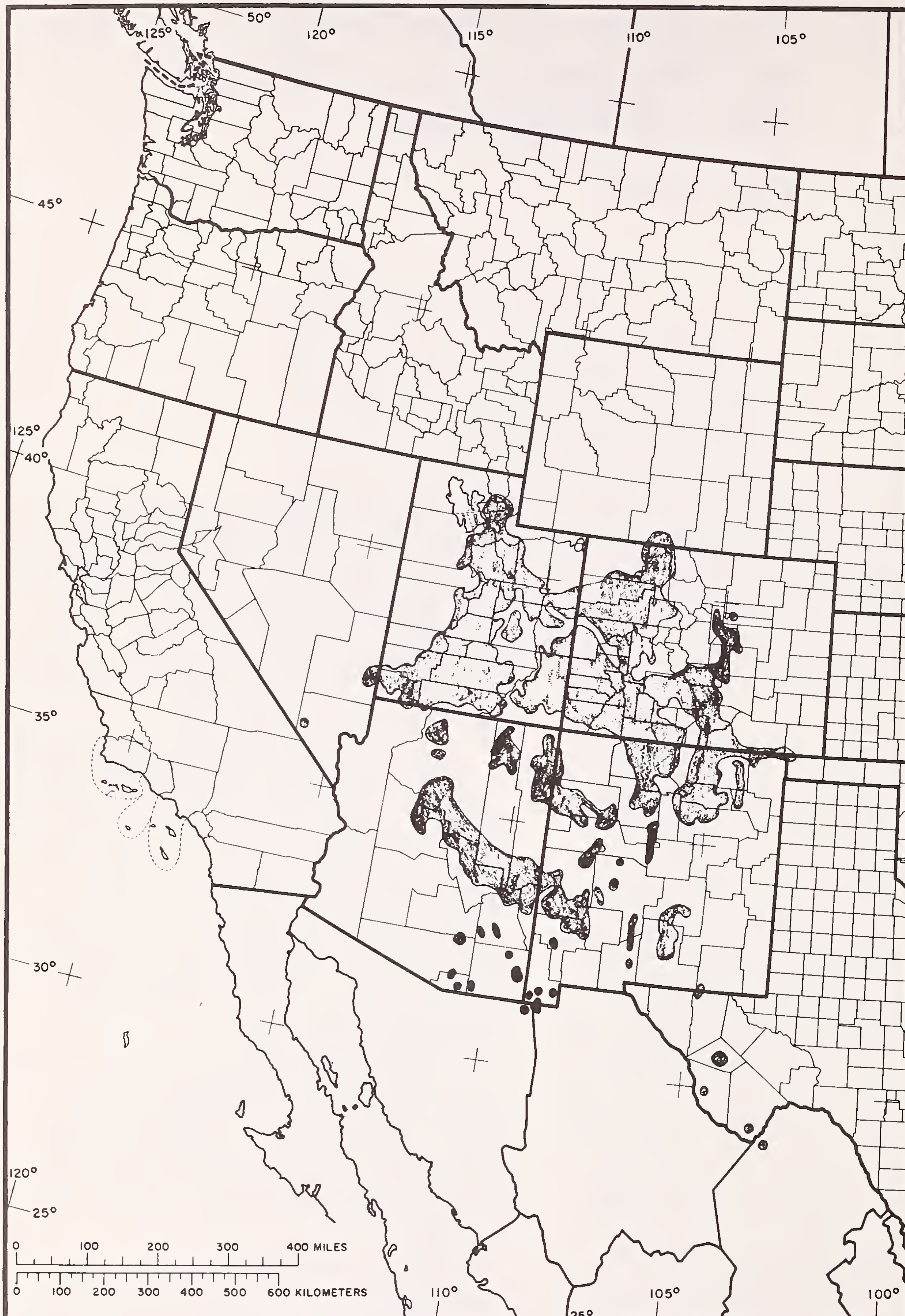

Figure 1.—Distribution of *Quercus gambelii* (from Little 1971).

METHODOLOGY

Information about the growth characteristics of oak was needed for determining rotation ages and volume increment per unit of land. The most important economic characteristics were retail price per unit of wood and costs of harvesting, transporting, handling, and selling.

Because production of harvestable fuelwood[1] was the primary concern, the clones chosen for sampling were to be readily accessible from an existing road. Also, a range of sizes was chosen to determine if a possible size-age relationship existed. The result of these selection criteria was that clones on better sites were sampled. These sites were on deep soils with considerable clay in the subsoil, which indicates high moisture-holding capability.

Samples were obtained from 18 clones of oak at 6 locations in north-central Utah. One site was in the Sheeprock Mountains southwest of Vernon. The remaining sites were in the Wasatch Mountains. Sites were located at Pole Canyon east of Nephi, southeast of Indianola, Lake Fork and Dairy Fork of Spanish Fork Canyon, and Monks Hollow in Diamond Fork of Spanish Fork Canyon. Five stems were sampled in each of 3 clones at each location for a total of 90 stems. The stem sizes were less than 4 inches (10.2 cm), 4 to 6 inches (10.2 to 15.2 cm), and over 6 inches (15.2 cm), representing the smallest size feasible for harvest to the upper end of the size spectrum. A section was cut from each stem at 12 inches (30 cm) above the ground surface. After air drying, the samples were sanded and treated with tung oil to facilitate counting of rings.

Measurements were also taken of stem diameter and density in seven stands in the Oquirrh Mountains, where the volume per stem had previously been determined to aid in estimating volume per land unit.

All 90 stem sections were marked and examined to determine the number of rings. Ring counts were made across the full diameter of stems, and the count for the two radii were averaged. Each ring was considered to represent a growing season. Growth per decade was determined by measuring the increase in diameter for successive decades (distance covered by 10 growth rings).

The net annual increment of growth for the stand is the statistic needed for decisionmaking. Because stand mortality over time is a key variable and determining it would require a major long-term study, an alternative method was used. Individual stem growth was estimated from the sample diameters and the biomass formula of Clary and Tiedemann (unpublished). This approach could be used for individual stands by estimating the number and diameter of stems.

Volume per stem was converted to kilograms by using the sample diameter estimates in the biomass formula:

$$\text{Log } Y = -0.169 + 2.04 (\log X)$$

Y = bole biomass in grams

X = basal diameter in mm (outside bark)

[1]In this report a size of 3.5 inches (8.89 cm) in diameter or larger is considered harvestable as fuelwood. Smaller stems are usable and harvested by wood gatherers in conjunction with larger material, but require too much effort per unit of wood to be feasible by themselves.

The results from application of this formula to the study stem section measurements were compared to estimates of volumes from seven stands in the Oquirrh Mountains and those estimated by others (Barger and Ffolliott 1972).

This study sought to find the most profitable age for harvesting a fuelwood crop. The annual addition of wood fiber or biomass would fix the physical parameter. The economic decision criterion would be the earning rate on alternative investments. The value added by allowing a stand to continue to grow could be compared with the economic return from harvesting and investing the return elsewhere. Costs for harvest, transport, process, and delivery of wood were determined by direct observation of harvesting operations and by reference to studies on fuelwood operations (Stine 1980; Johnson and Grosjean 1980).

Selling prices of oak wood were determined by sampling classified advertisements in two major Utah newspapers over 3 years (Provo Herald 1980-82; Salt Lake Tribune 1980-82). Each ad with a price quotation was listed by telephone number. The price for each phone number was used only once. A refinement would be the weighting of prices depending upon the volume of wood sold by each operator during a year.

RESULTS

After analyzing the age data from the stem samples, no distinct slowing of radial growth with aging could be determined. The width of growth rings for any given location was remarkably similar for all three size classes. The larger trees were older, as shown by the data in table 1 and figure 2. The comparison of clones at a location or among locations should be done with great caution because environmental variation could be significant.

The data indicate differences in rate of growth among the sampled clones, but the causal variables could not be readily determined. Some genetic variation undoubtedly exists because the samples from the Sheeprock location have a bark markedly different from the other samples. Environmental factors could differ enough to affect rate of growth. Variability among clones across the range of oak has also been observed by Brown 1958, Barger and Ffolliott 1972, and Kunzler and others 1981.

The basal area of stems was increasing measurably for all stems in the sample (fig. 3). Taken by itself this physical attribute would suggest long rotations and large diameter trees. There is one major factor not measured that could modify this conclusion. Mortality of stems within a given clone must be taken into account. Perhaps reduction of stem numbers offsets growth of those alive, so that while individual trees grow, total live standing biomass would not increase.

Although the absolute basal area increased at a slightly increasing rate for all ages sampled, the annual increment of growth expressed as an annual percentage declined rapidly at younger ages and became relatively stable at older ages. The percentage change in biomass data was plotted over time to show the changing incremental rate of biomass increase (fig. 4).

Table 1.—Estimated age of Gambel oak in north-central Utah[1]

	Sizes							
	Small		Medium		Large		All	
Site	Diameter	Ring	Diameter	Ring	Diameter	Ring	Diameter	Rings
	Inches	*No.*	*Inches*	*No.*	*Inches*	*No.*	*Inches*	*No.*
Indianola	3.8	94	4.8	102	5.6	104	4.8	100
North Oakbrush	3.6	68	5.1	70	7.0	100	5.3	79
Pole Canyon	3.6	87	4.2	96	6.1	103	4.6	95
Lake Fork	3.6	79	4.6	96	6.3	101	4.8	92
Monks Hollow	3.0	68	5.0	114	6.4	123	4.8	102
Dairy Fork	4.0	87	4.8	111	6.8	113	5.2	104
All	3.7	81	4.8	98	6.4	107	4.9	95

[1]Five samples were included in each size at each site for a total of 90 samples.

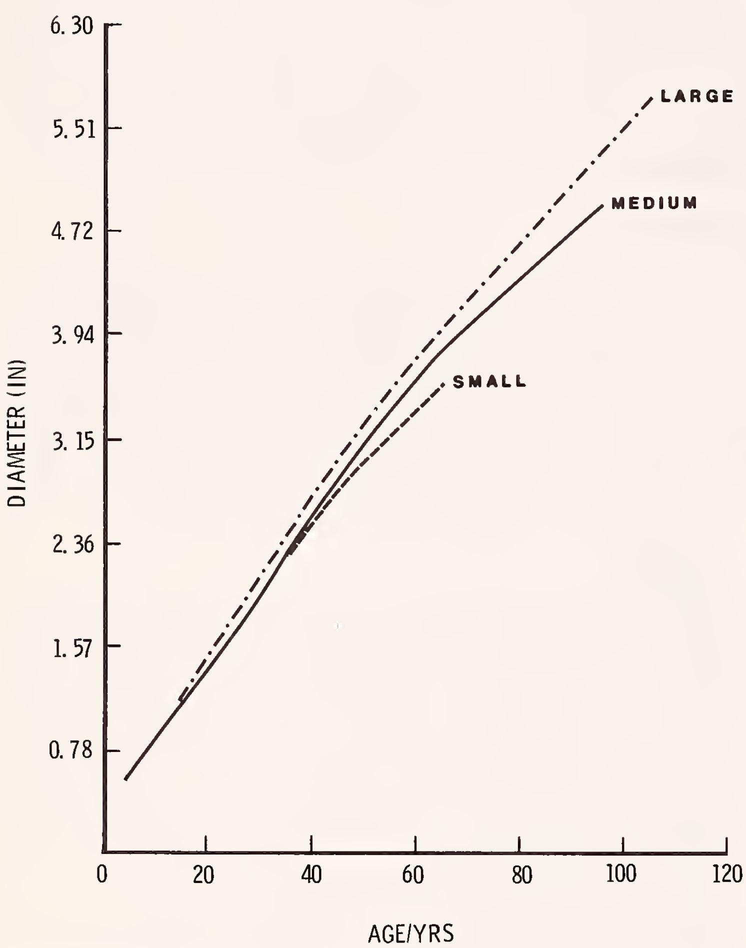

Figure 2.—Cumulative average diameter of 18 clones of oak, north-central Utah.

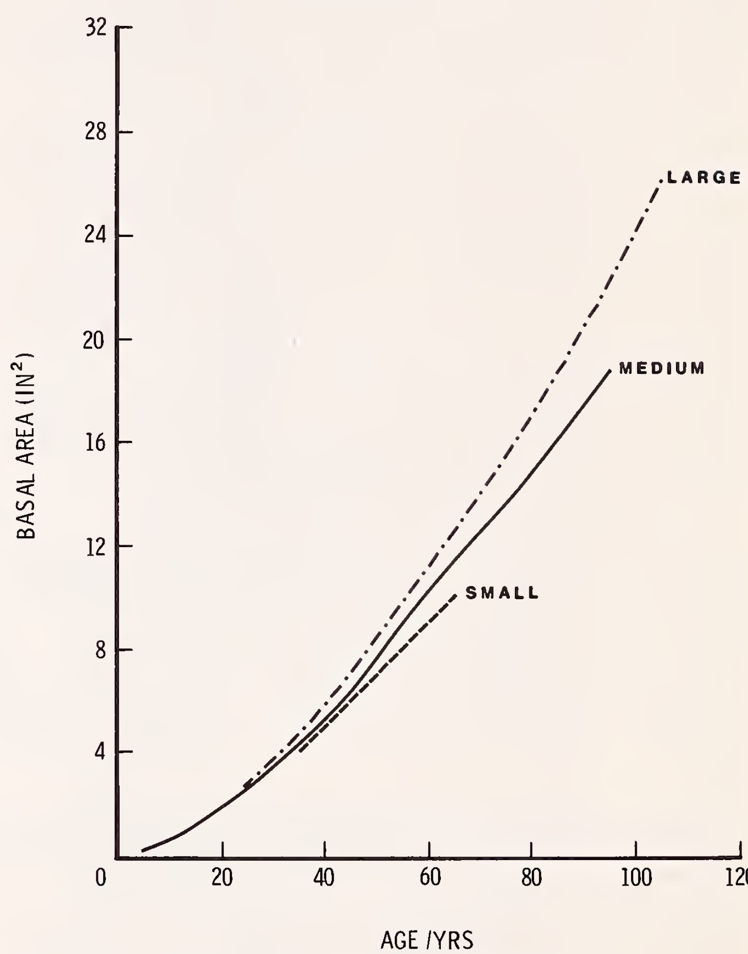

Figure 3.—Cumulative basal area per stem, average of 5 stems of 3 sizes from 18 clones, north-central Utah.

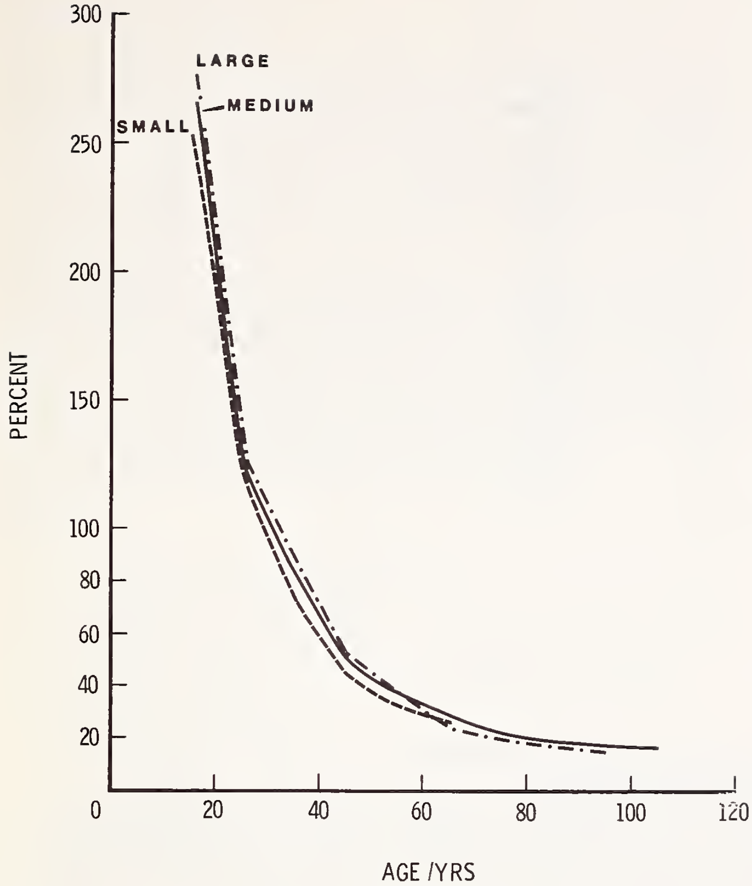

Figure 4.—Percentage decade change in biomass for 30 stems of each of 3 sizes of oak, north-central Utah.

Stand density, height, diameter, mortality rate, growth rate, and associated vegetation vary widely (Kunzler and others 1981; Tiedemann and others, unpublished; Brown 1958; Horton 1975; Wright and others 1973). Selected characteristics of seven stands in the Oquirrh Mountains of north-central Utah are shown in table 2. The sample data fit within the ranges observed in the Oquirrh Mountain stands and those recorded by other observers (Harper and others, unpublished; Reynolds and others 1970; and Brown 1958). The most realistic expression of volume per unit area of land appears to be per stocked acre or the area within clonal boundaries. Using stocked acres as the basic measure of volume is consistent with the procedure used for other tree species. This would reduce the variability in per-acre-volume estimates caused by interclonal spacing. But intraclonal or within-stand differences will still cause considerable variation in estimates of volume.

Estimated volume per stem and current stumpage value per stem are shown in table 3. Value per stem is based on a budgeting process where the retail selling price was used as the base and the expense items deducted to get the stumpage price (table 4.) The stumpage value estimates were validated by comparing with advertised selling prices of oakwood on the stem (Provo Herald 1982). Total value for a given area or clone could be obtained by multiplying the values per stem by number of stems in the area being considered.

Table 3.—Estimated volume and value per stem of oak from 18 Stands at 6 locations, north-central Utah

Stand	Average Diameter	Basal area	Volume[1]	Value[2]
	Inches	*Inches²*	*Lb/stem*	*$/stem*
1-S	3.58	10.04	19.58	$0.098
2-S	3.62	10.29	20.1	.101
3-S	3.86	11.69	22.88	.115
4-S	3.03	7.2	13.99	.070
5-S	3.98	12.44	24.33	.122
6-S	3.62	10.29	20.11	.101
Total-S	3.62	10.29	20.11	.101
1-M	5.12	20.59	40.79	.204
2-M	4.57	16.40	32.27	.162
3-M	4.84	18.40	36.37	.182
4-M	4.96	19.32	38.19	.191
5-M	4.84	18.40	36.37	.182
6-M	4.21	13.92	27.37	.137
Total-M	4.76	17.80	35.16	.176
1-L	7.01	38.59	77.29	.387
2-L	6.34	31.57	62.99	.316
3-L	5.63	24.89	49.46	.248
4-L	6.46	32.78	65.38	.328
5-L	6.77	36.00	72.07	.361
6-L	6.10	29.22	58.28	.292
Total-L	6.38	31.97	63.78	.320

[1]Bole volume only; branches would add to volume.
[2]Based on stumpage of $10/ton or $17.70/cord. 1 cord = 1.77 tons.

Table 2.—Estimated volumes of fuelwood from seven stands of Gambel oak in Oquirrh Mountains, Utah

Stand No.	Tree characteristics: Diameter	Number per acre[1]	Height	Volume: Ft³/tree	Cords
	Inches		*Feet*		
1	8-10	1,742	25	6	130
2	3-4	3,920	15	0.5	25
3	3-5	4,791	20	.75	45
4	7-10	700	20	3.5	30.6
5	4-6	1,306	15	1.0	16
6	4-6	700	12	.75	6.5
7	6-7	957	20	1.5	18

[1]Includes only area within clonal boundary.

Table 4.—Estimated cost of harvesting, handling, and marketing Gambel oak Firewood in north-Central Utah, 1983

Item	Units of measure or description	$/ton	$/cord[2]
Stumpage	Land owners gross return	10	17.70
Harvest	Fall, trim cut to length[1] 2 h/ton @ $10/h	20	35.40
Yarding	5 miles average load and haul	10	17.70
Split	Split pieces over 6 ft diameter in two	5	8.85
Load	10 ton loads 4 work hours @ $5	2	3.54
Haul to market	$2/mile, average 100 miles	20	35.4
Profit	Harvester	8	14.12
	Wholesale price	75	132.75
Delivery	Per unit	10	17.70
Profit	Retail/unit	10	17.70
Price	Delivered to consumer	95	168

[1]Includes a worker who furnishes own chain saw, etc.
[2]Cord is estimated as being 3,548 lb air dry or 1.77 tons.

Financial maturity of stands can be estimated by comparing the annual growth expressed as an annual percentage with the expected rate of alternate earnings of invested capital. For instance, once oak has achieved the minimum harvestable size it could be harvested immediately or at some later time. Harvesting at a later time has some economic costs associated with the passage of time, including some direct management costs and risks of loss due to fire, theft, insects, or disease. As shown in figure 5, oak reaches harvestable size at about 65 years. The annual percentage rate of growth at 65 years is less than 3 percent (fig. 6). Unless a low rate of return is acceptable, harvesting oak as soon as it reaches harvestable size would be most profitable.

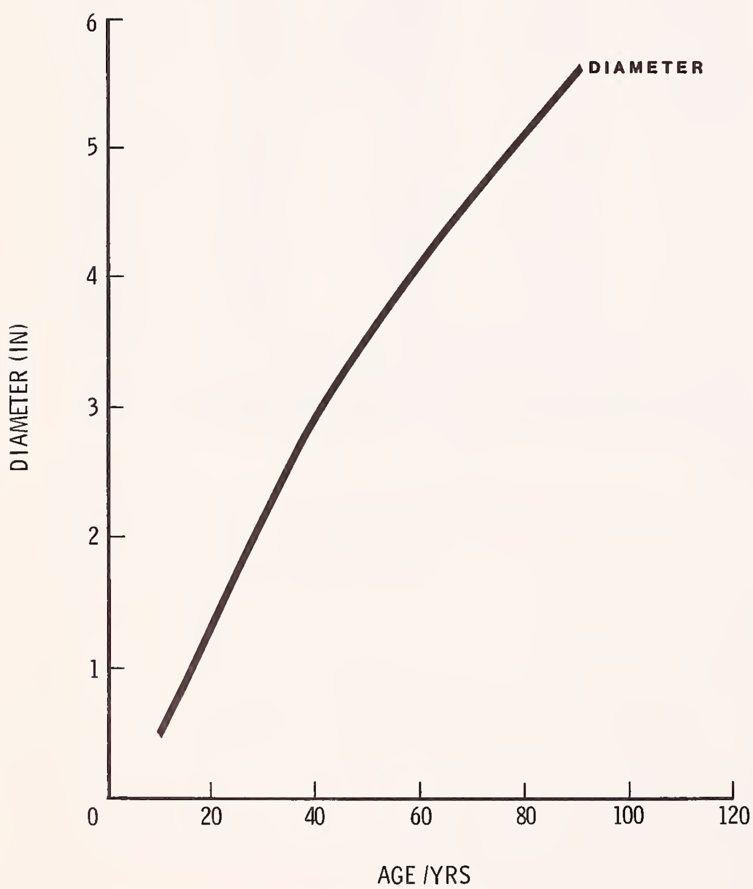

Figure 5.—Cumulative average diameter of 90 oak stems for 18 clones, north-central Utah.

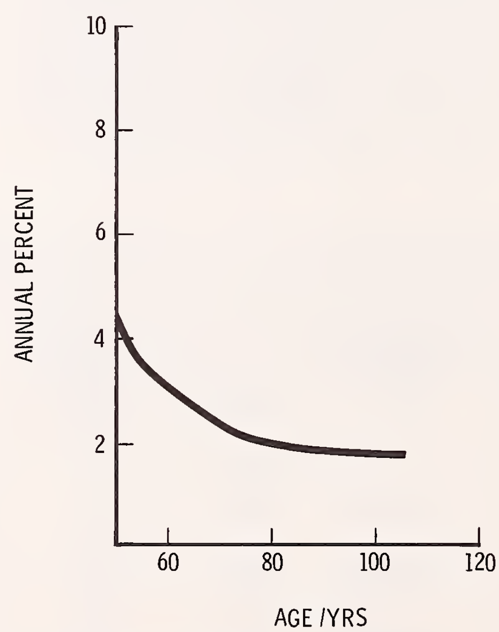

Figure 6.—Average annual percentage growth per stem of oak, north-central Utah.

DISCUSSION

Data from the sample stands can be used to demonstrate the application of economic criteria to selecting a harvest strategy, although the comparison of clones at a location or among locations should be done with great caution because environmental variation could be significant.

Economic criteria can be used to derive the most profitable harvest decision once a minimum rotation age (the age stems reach 3.5 inches or 8.9 cm) is established. If the rate of value increase for a mature stand exceeds the economic return of the best alternative investment plus the other costs of holding the oak on the stem, harvesting should be delayed. An example:

Where

R = economic return from alternate investment expressed as a percentage

A = minimum rotation age = 65 years (when average basal diameter reaches 3.5 inches or 8.9 cm)

C = cost of holding (risk, management, protection, taxes, and so forth)

$$G = \text{percentage growth rate of oak} = \frac{\text{volume added during year}}{\text{volume at start of year}}$$

In this example:

A = 65 years

R = 8 percent per year

C = negligible

G = 2.85 percent per year (for sample 65 to 70 years), see figure 6

Harvest would occur because $G < R$ (2.8 percent < 8 percent).

The growth rate (G) is much less than the earning rate (R) of the alternate investment and the stand is mature, so immediate harvest is the most profitable alternative. The stumpage price per unit of oak as fuelwood does not increase as size increases, although value of individual trees becomes greater due to increasing volume. If stumpage prices are expected to change over time, another variable reflecting this could be included in the calculation.

Figure 6 can also be used as guidance for public land managers. All growth rates beyond 65 years are less than the 4.12 percent minimum return expected by the Office of Management and Budget on public investments to show economic feasibility. This suggests that a strategy of harvesting at the youngest age possible is economically superior to older ages.

A further extension of the example may prove instructive. Table 2 shows that stand 7 in the Oquirrh Mountains has 957 trees per acre of a 6- to 7-inch (15.2- to 17.8-cm) size. If similar to the sample, these trees would be about 100 years old and would yield about 18 cords per stocked acre. Plugging these numbers into the formula yields the results.

The annual return from an alternate investment would be:

$$R_a = R\,(V \times P)$$

where

R = 8 percent

R_a = annual return

V = cords per acre (18)

P = stumpage price per cord ($17.70)

V × P = total stumpage value per stocked acre

Solving the equation yields:

R_a = 0.08 ($318.60)

R_a = $25.49

Allowing the stand to grow would yield the following change in value by using two formulas:

$$V' = G \times V$$

where

V' = added volume

G = percent rate of growth (1.8 percent)

V = stand volume at start of year (18 cords)and

$I = V' \times P$

where

I = increased value per stocked acre

V = added volume expected

P = price per cord ($17.70)Solving the formulas by use of the sample data yields:

$V' = G \times V = 0.018 \times 18 = 0.324$ (cords)

$I = V' \times P = 0.324 \times \$17.70 = \$5.73$

The value of the increased growth during the year is $5.73, while the expected return from the alternative investment would be $25.49. If the costs of holding the growing stock (C) were significant due to mortality, theft, disease, insects, fire, or other costs, the value difference in favor of immediate harvest would be larger.

CONCLUSIONS

For the area represented by the sample productive sites in north-central Utah, Gambel oak can successfully and economically be managed for fuelwood where markets exist and competitive uses of the land are limited. A rotation age of 65 years would allow most clones to grow trees that exceed the mininum fuelwood size of 3.5 inches (8.9 cm). Current retail stumpage prices of oak clones in this study, if harvested for fuelwood, would range from $115 to $2,300 per stocked acre.

Considering the high yields on investments in treasury bills, savings certificates, and other low-risk investments, and the low annual percentage growth of older oak, holding growing stock is not the most profitable management strategy. Old growth stands could be converted to young stands which have a higher annual percentage rate of growth and the revenue received invested at high rates of return. Costs of managing and holding oak on the stem need further study because they may be significant and could affect harvest decisions.

Because of variation among clones and locations, caution in directly applying results of this study is needed. Specific locations may well have different growth rates, yields, and market values. There appears to be a strong market for oak as fuelwood, and as a result stumpage prices are expected to remain the same or even increase. Values of the standing crop of wood are significant. The value of Gambel oak land as a wood-producing site could well exceed other uses of the land.

REFERENCES

Arnow, Lois A. Vascular flora of Red Butte Canyon, Salt Lake County, Utah. Salt Lake City: University of Utah, Department of Biology; 1971. 388 p. M.S. thesis.

Barger, Roland L.; Ffolliott, Peter F. Physical characteristics and utilization of major woodland tree species in Colorado. Research Paper RM-83. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1972. 8 p.

Brown, Harry E. Gambel oak in west central Colorado. Ecology. 39(2): 317-326; 1958.

Christensen, Earl M. The ecology and geographic distribution of oak brush (*Quercus gambelii* in Utah. Salt Lake City: University of Utah; 1949. 70 p. M.S. thesis.

Horton, L. E. An abstract bibliography of Gambel oak (*Quercus gambelii* Nutt.). Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Region; 1975. 64 p.

Johnson, Carl M.; Grosjean, Mike J. Wood for heating Utah homes, an asset or liability? EL 95. Logan, UT: Cooperative Extension Service, Utah State University; 1980. 9 p.

Kufeld, Roland C.; Wallmo, O. C.; Feddema, Charles. Food of the Rocky Mountain mule deer. Research Paper RM-111. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1973. 31 p.

Kunzler, L. M.; Harper, K. T.; Kunzler, P. B. Compositional similarity within the oakbrush type in central and northern Utah. Great Basin Naturalist. 4(1): 147-153; 1981.

Little, E. L., Jr. Atlas of United States trees. Volume 1. Conifers and important hardwoods. Miscellaneous Publication 1146. Washington, DC: U.S. Department of Agriculture, Forest Service; 1971. Unpaged.

Marquiss, Robert W Gambel oak control studies. Down to Earth. 27 (2): 22-24; 1971.

Provo Herald. Daily newspaper classified ads, August-September 1982. Provo, UT.

Provo Herald. Various dates 1980-82. Provo, UT.

Reynolds, Hudson G.; Clary, Warren P.; Ffolliott, Peter F. Gambel oak for southwestern wildlife. Journal of Forestry. 68(9): 545-547; 1970.

Salt Lake Tribune. Various dates 1980-82. Salt Lake City, UT.

Stine, Raynold. Economics of utilizing oak for energy. In: Proceedings of the symposium on the ecology, management, and utilization of California oak. General Technical Report PSW-44. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1980: 345-353.

U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1980: 345-353.U.S. Department of Agriculture, Forest Service. Interim management plan for Gambel oak on the Uinta National Forest. Provo, UT; Uinta National Forest; 1983. 12 p.

Van Epps, Gordon A. Control of Gambel oak with three herbicides. Journal of Range Management. 27(4): 297-301; 1974.

Welch, Bruce L.; Monsen, Steven B.; Shaw, Nancy L. Nutritive value of antelope and desert bitterbrush, Stansbury cliffrose, and apache-plume. In: Proceedings—research and management of bitterbrush and cliffrose in Western North America; 1982 April 13-15; Salt Lake City, UT. General Technical Report INT-152. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1983: 173-185.

Wright, H. E., Jr.; Bent, Anne M.; Hansen, Barbara Spross; Maker, L. J., Jr. Present and past vegetation of the Chuska Mountains, Northwestern New Mexico. Geological Society of America Bulletin. 5(84): 1155-1180; 1973.

Wagstaff, Fred J. Economic considerations in use and management of Gambel oak for fuelwood. General Technical Report INT-165. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1984. 8 p.

Basic economic analysis determined values of oak as fuelwood in north-central Utah. If owners of oak are to maximize economic returns, they must determine whether to harvest and invest the sale proceeds or let stands grow. Older stands have a lower annual percentage growth rate, so the alternative of earlier harvest, which frees capital for investment at current high rates of return, is very attractive.

KEYWORDS: Gambel oak, economics, economic analysis, fuelwood, optimum rotation age, harvest cost, returns

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